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FILARIASIS

(A training module for middle level worker)

VECTOR CONTROL RESEARCH CENTRE

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INDIA

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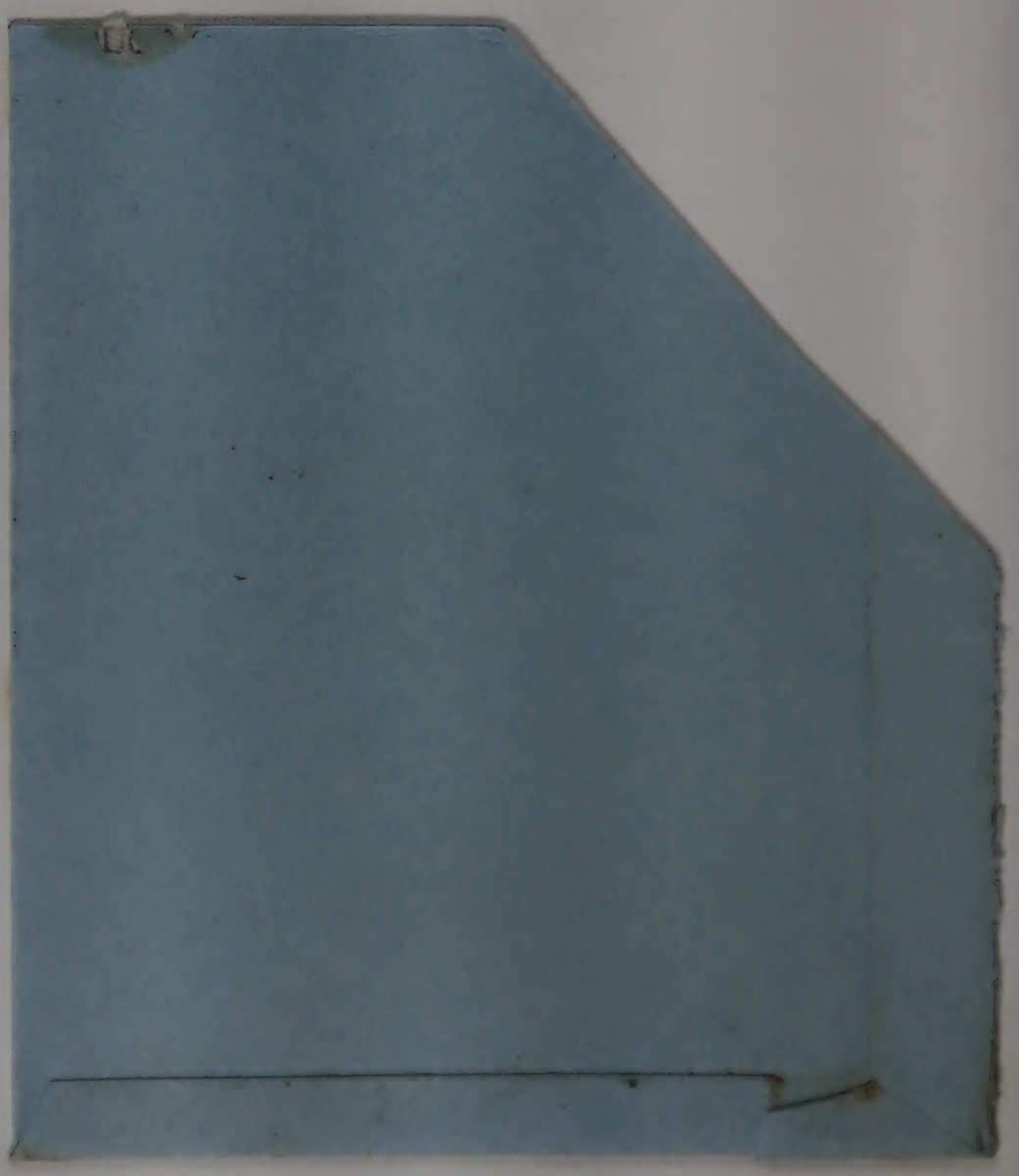

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FILARIASIS

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INTRODUCTION :

Filariasis is the common term for a group of diseases caused by certain nematode worms. **In India, the most common form of this disease is caused by** *Wuchereria bancrofti* **and is known as Bancroftian filariasis accounting for 99% of the cases.** This form of filariasis is widely distributed both in urban and rural areas (Fig.1).

The other form of this disease is caused by *Brugia malayi* and is commonly termed as Brugian (Malayan) filariasis. This is restricted to few rural pockets in the cc ntry and the largest endemic tract presently exists along the central part of Kerala. The other localised foci are in Assam, Orissa, Madhya Pradesh and West Bengal (Fig.1).

Since these parasites affect primarily the lymphatic system of man, the disease caused is also commonly termed as Lymphatic filariasis. **It is estimated that in India about 304 million population is exposed to the risk of filarial infections, with 22 million infected individuals and 16 million persons with the chronic disease.**

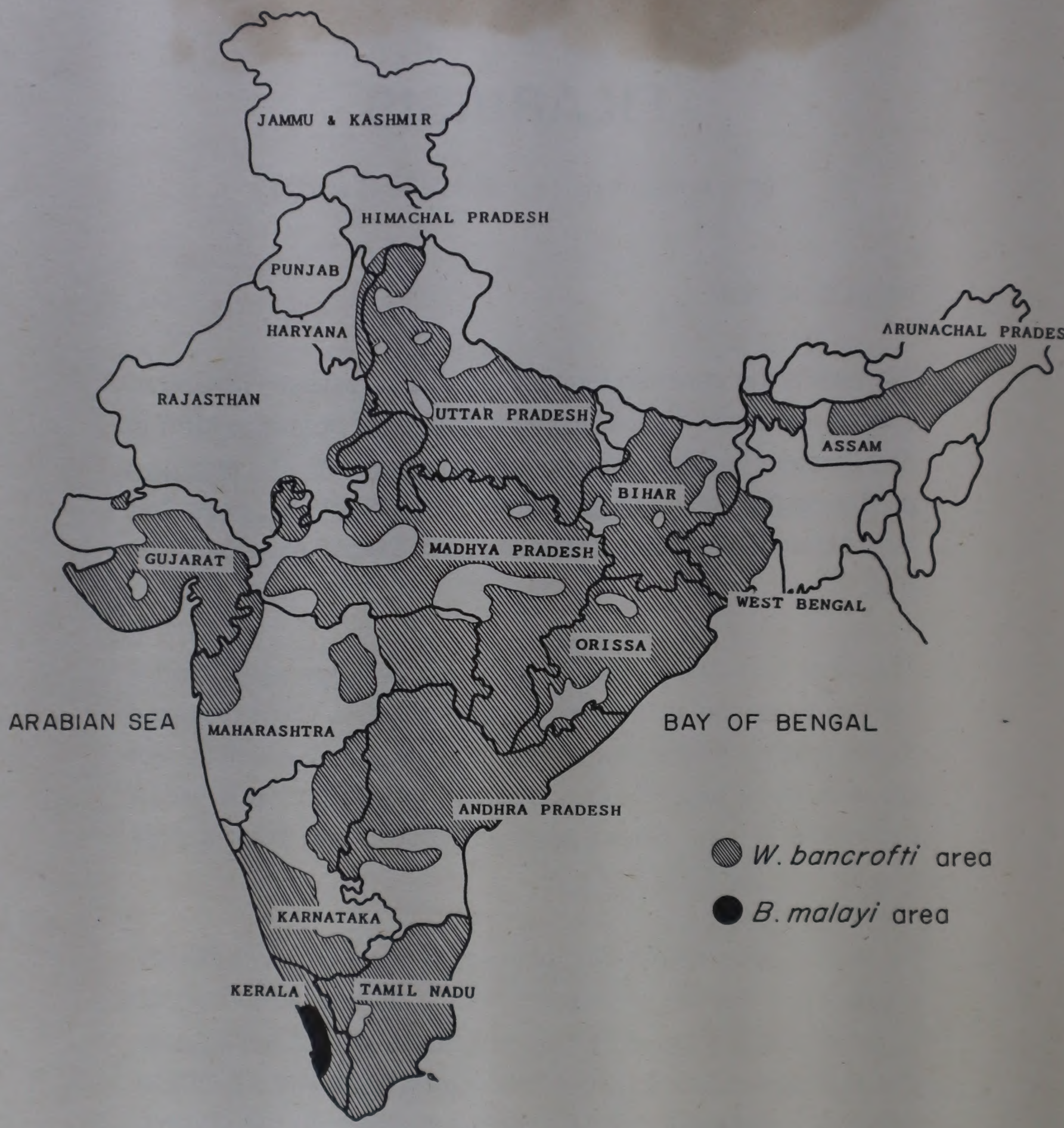


FIGURE:1. Distribution of bancroftian and malayan filariasis in India

Though mortality due to filariasis is negligible, there is a high degree of morbidity due to its acute and chronic manifestations. In the acute stages the disease manifests in the form of lymphangitis, adenitis, filarial fever, funiculitis, epididymo-orchitis and tropical eosinophilia and in the chronic phases presents as hydrocele, chronic oedema and elephantiasis. While chronic swelling of limbs is common to both Bancroftian and Brugian forms, funiculitis, epididymo-orchitis and hydrocele are rare in the latter. A person may continue to be a microfilaria carrier without any disease manifestation for a prolonged period, and individuals with chronic disease on the other hand are usually negative for microfilaria.

LIFE CYCLE OF FILARIAL PARASITES :

The adults of both *W. bancrofti* and B. malayi, are thread like worms measuring 4 - 10 cms long. They are lodged in the lymphatic system of man. The female and male worms mate within the human body and the fertilized female liberates thousands of larvae, known as microfilariae (mf). During day time microfilaria remain concentrated in the capillaries and blood vessels of internal organs especially lungs. These are released into the blood stream and circulate in the peripheral blood at night periodically. Further development of the mf can take place only in the body of the mosquito vector. Interestingly the nocturnal (night) appearance of the mf in the blood of man synchronizes with the biting period of the vector mosquitoes and depends upon the sleeping habits of man (Fig.2).

The mf ingested by the mosquitoes along with the blood, sheds it's body cover and migrates to the thoracic muscle of the mosquito, where it undergoes two moultings to become the infec-

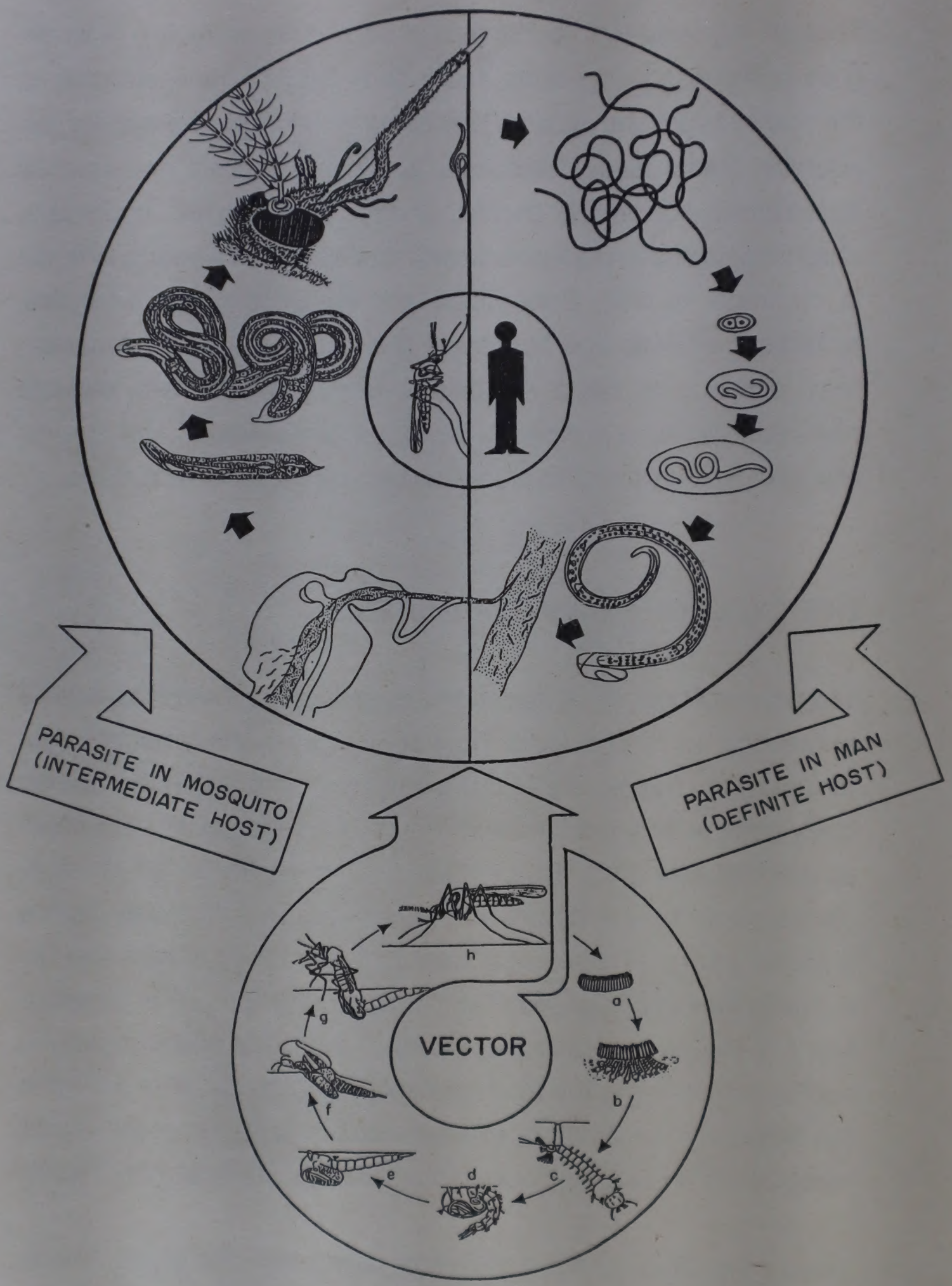


FIGURE:2. Life cycle of the filarial parasite and its vector

tive larvae in about 10 - 12 days. This infective stage larvae migrate to the proboscis (mouth parts) of the mosquito. When the infective mosquito feeds on man, these larvae are deposited on the skin near the site of the bite. A few of them succeed in penetrating the wound. Several microclimatic factors like humidity, temperature etc., influence the successful entry of these larvae into the human body (Fig.2). The infective stage larvae develop into adult worms within human body and this development takes approximately one year. Whereas the adult males live for a short period, the females can survive for long (may be as long as 40 - 50 years). The production of microfilaria within the body of man is dependent on the probability of the male and female worms getting lodged within the same lymphatic channel. **Therefore, unless the number of vectors are high with a heavy load of mf in the population, the probability of transmission of this disease is very low. A large number of infective bites are necessary for patent microfilaraemia.** Single worm single sex infections may also cause clinical symptoms but not microfilaraemia. Indirect evidence suggests that the duration between infective bite and production of microfilaria is about one and half years for W. bancrofti and 9 months to one year for B. malayi

VECTORS OF FILARIASIS IN INDIA :

Both forms of filariasis are transmitted from man to man by female mosquitoes. While Culex quinquefasciatus is the major vector of bancroftian filariasis, brugian filariasis is transmitted by Mansonia mosquitoes.

High density of *Cx. quinquefasciatus* is maintained in urban areas due to gross mismanagement of the environment. The vector mosquito has successfully exploited the environmental changes brought about by man. Deterioration of sanitary conditions aided the geometric increase in the number of breeding habitats of this vector. Even though this species can breed in any aquatic habitat, highly polluted stagnant water bodies rich in organic matter provides an ideal environment for its proper development. **Hence habitats, such as pit latrines, soakage pits which are designed to collect waste water, open septic tanks, biogas plants, non flowing drains, cesspits, choked storm water canals, etc., are the major breeding sites of this mosquito.**

Mansonia mosquitoes namely M. annulifera, M. uniformis and M. indiana, the vectors of Brugian Filariasis, require the presence of hydrophytes (water weeds) for completing their life cycle. The larvae of these mosquitoes attach to the roots of plants like Pistia, Eichornia and Salvinia for their oxygen requirement.

CONTROL OF FILARIASIS :

Filariasis can be controlled by any of the three following methods in isolation or in combination:

(a).Reduction of man-vector contact by Vector control;
(b).Reduction of the parasite reservoir in man by chemotherapeutic measures., and,
(c).Reduction of man vector contact by personal protection.

A. **Vector control**:

Due to the difference in vectors and their ecology, the two forms of filariasis necessitate different approaches to vector control. Theoretically vector control can be achieved by directing control measures either against the adult or the immature larvae.

i. Anti-adult measures:

Adult population can be reduced by residual spraying (spraying of surface with insecticide which may persist for variable periods of time, usually months, so as to cause mortality in resting insects on contact with the treated area (residual spray) or space spraying (atmospheric spraying of insecticide for immediate killing or knock down of flying as well as resting insects in a specified unit area.) with insecticides of choice. However residual spray is not very effective against Cx. quinquefasciatus due to change in resting behaviour and development of resistance. Space spray at regular intervals though effective is cost prohibitive in the absence of any antilarval measures. Any temporary suppression of population by spray can be compensated by the high reproductive potential of the vector Cx. quinquefasciatus.

ii. Anti-larval measures:

Antilarval measures are the most effective method for controlling the vectors. The fact that larvae are in confined breeding habitats, facilitate easy attack on the immature stages. **Breeding of Cx. quinquefasciatus can be prevented by elimination, reduction or modification of breeding habitat by simple sanitary**

measures. Wherever breeding can not be prevented, larval control can be achieved by use of biological or chemical larvicides.

a). **Environmental management is the most cost effective method of controlling Culex vectors. Since a majority of the breeding habitats are created by bad engineering practices and are man made, permanent elimination of these habitats by better engineering practices leading to source reduction should be the first priority in controlling the vector**. Similarly physical removal of weeds is the most effective and easy method of Mansonia control.

b). Biological agents such as larvivorous (Gambusi, Poecilia,(guppy), Tilapia) and phytophagous (Chinese grass carp) fishes and several microbial agents (Bacillus sphaericus) can be particularly effective against larvae.

c). A high degree of larval control can be achieved by routine application of chemical larvicides in polluted breeding habitats. These however, are not suitable for control of Mansonoid larvae which breed in large fresh water bodies which are also used for domestic purposes.

B. **Chemotherapy**:

Diethylcarbamazine (DEC) is the only drug of choice available at present. This drug primarily kills microfilariae. Since in many cases mf reappears after certain period, the effect of the drug on adult worms has been doubted. Moreover, multiple doses are required over a long time, and that death of mf during treatment frequently causes unpleasant reactions in the host (side effects). (DEC should

not be administered to patients with acute filarial symptoms, since the conditions may aggravate due to side reaction.) These side effects are relatively more severe in Brugian filariasis. These factors frequently deter public cooperation for chemotherapy. DEC can be administered either to the entire community (mass chemotherapy) or only to microfilaria carriers (selective). Both have their own advantages and disadvantages. **The choice would depend upon the size of the target population, mf prevalence, man-power and resources available and the acceptance of the community**.

Mass treatment with DEC can bring down parasitic load in a community within a short period, and, therefore it is recommended in a community with high microfilaria prevalence and where public participation can be assured. Administration of DEC through food medium like medicated salt is another useful method for mass chemotherapy. Community acceptance of mass chemotherapy has been a problem in Brugian filariasis control, due to severe side reactions. Selective treatment of microfilaria carriers on the other hand requires continuous surveillance, public acceptance (due to night time survey) and the prohibitive cost involved in the venture.

The recommended dosage for treatment of parasite carriers is 6 mg per kg of body weight, daily for 12 days. In some situations single dose of DEC once or twice a year can also be used as a prophylactic measure with promising results.

A new drug, Ivermectin, is now undergoing clinical trials and offers some hope in curing man of infection with a single dose treatment.

C. **Personal protection**:

Protective clothing, repellants, bed-netting, avoidance of mosquito biting environments and screening houses are common sense elements in prevention and control. The keys to the implementation of these personal measures are health education and socio-economic development. The use of synthetic pyrethroid impregnated nets is another recent development but is yet to become operational.

MONITORING AND LONG-TERM EVALUATION

This should form an integral part of the control program and should be based on repeated measurements of the vector and parasite population. The important parameters for this evaluation are man biting density (average number of female mosquitoes biting man per night), infection, and infectivity rates (proportion of mosquitoes with any stage larvae and only infective larvae respectively.) of vector mosquitoes, and transmission potential (estimated number of infective bites). The parasitological indices which need to be monitored are incidence of infection (estimated number of new cases appearing in a community within a given period), prevalence of microfilaraemia (proportion of population with microfilaria in blood) and median microfilarial density (mean worm burden in infected persons).

SURVEY TECHNIQUES IN FILARIASIS

For assessment of filariasis situation, in a given community, parasitological clinical and entomological surveys should be carried out at regular intervals.

Parasitological

Detection of microfilaria in blood is still the most reliable method of confirming filarial infection. As microfilaria appear at night in peripheral blood (not in subperiodic forms) blood survey has to be carried out at night after 8 PM. For a reliable estimation of prevalence a minimum of 10% of the population should be sampled. The sample should be selected in such a way that all age groups, and both sexes are represented proportionately. To study the phenomenon of spatial distribution proportional sample should be collected from each area. A drop of blood (approximately 20 cubic mm) should be collected by finger prick method and a thick smear should be made with the help of a spreader. Three large drops of blood (60 c.mm) would be more ideal in mass surveys, but this may pose problems. The smears should be dehaemoglobinized (after 12 hours) by tap water, fixed with methanol and stained using any of the Romonwsky's stains (JSB , Giemsa, Leishman etc.). The smears should be examined microscopically for microfilaria presence (Fig.3).

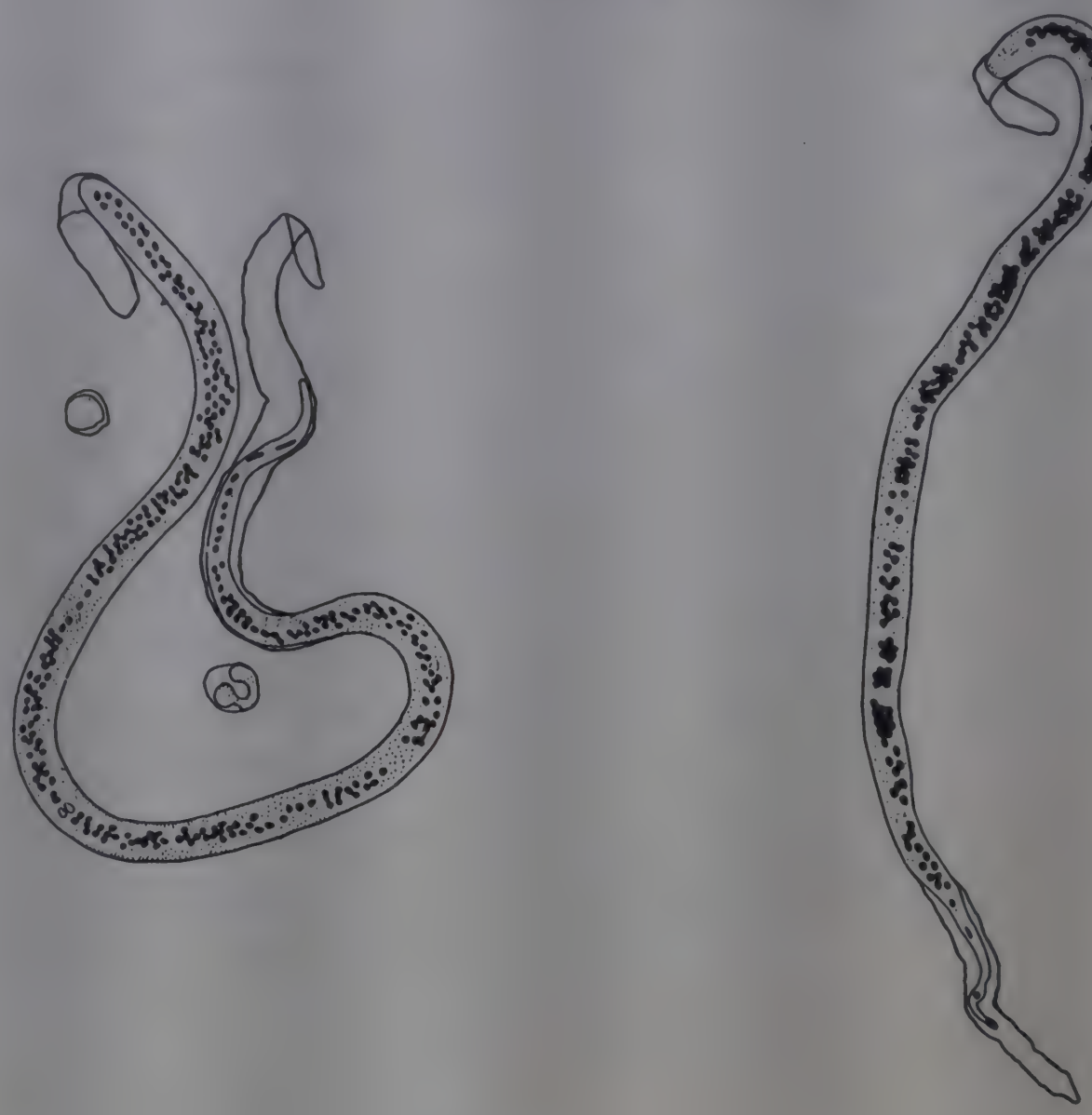
Difference between W. bancrofti and B. malayi mF

CHARACTER	W. bancrofti	B. malayi
1. Size	longer (290 u)	shorter (230 u)
2. Body shape	folded in smooth curves	folded with tight twist
3. Tail tip	nuclei [redacted] swelling absent	nuclei [redacted] swelling present

Wuchereria bancrofti

Brugia malayi

MICROFILARIAE



Tails of infective larvae

FIGURE:3. Differences between W. bancrofti and B. malayi

Clinical survey

The prevalence of disease can be estimated by a clinical survey, by medical personnel and the sample size of the survey should be calculated as per previous estimates of prevalence in the locality and minimum 3 to 5% of the population should be surveyed depending upon logistics. This should also be done by a door to door survey and not by health camps. Selective attendance of diseased persons in a health camp may result in a higher estimate of prevalence.

The personnel involved should be trained on the accurate diagnosis of various manifestations of filariasis. A team should include a lady doctor (apart from a male doctor) to facilitate detailed examination of females. The criteria for diagnosis of different manifestations of filariasis are given below.

a) *Acute Manifestations*:

1. Lymphangitis: Acute inflammation of lymph channels, resulting in reddish streaks on skin over the lymphatics. These start from a lymphnode usually in the groin or armpit and progress away from the node. This is usually associated with fever and enlargement of lymphnodes.

2. Thick Lymphatic Trunk: The lymphatic channel gives a cord like feeling on touch and usually associated with enlarged lymph node which is not painful. The skin does not show any reddish streak as in lymphangitis and the patient is generally afebrile. Since thick lym-

phatic trunk follow lymphangitis, history of the same should be elicited for confirmation.

3. Funiculitis: This is an acute painful inflammation of the spermatic cord. This is usually associated with fever and inflammation of testis and painful glands in the groins. This condition though usually unilateral, can sometimes be bilateral.

4. Epididymo-orchitis: This is an acute painful condition involving the testis and epididymis. This may result in some degree of scrotal swelling with redness. This is usually associated with fever, funiculitis and lymphnode enlargement in the groin.

5. Filarial Fever: Fever with chills and rigors, low to high grade (38-40^{o}), subsiding with sweating (does not show periodicity like malaria) associated with painful lymphnode enlargement and lymphangitis. Fever persists for 3-5 days.

6. Adenitis: Enlarged soft painful lymphnodes usually in groin or arm pits with free skin above it. Sometimes gets infected with bacteria and pus formation may occur. This condition is usually associated with fever, lymphangitis, funiculitis and epididymo-orchitis.

7. Tropical Pulmonary Eosinophilia (TPE): Individuals complaining of difficulty in breathing, associated with or without wheeze (as in Asthma) and living in filaria endemic areas should be suspected for TPE. If these patients are amicrofilaraemic and respond favorably to DEC treatment, a tentative diagnosis of TPE is indicated.

b) *Chronic Manifestation*:-

1. Hydrocele: Repeated attacks of epididymo-orchitis and funiculitis results in accumulation of clear fluid in the covering of testis. This results in unilateral or bilateral scrotal swelling, which is usually not painful. Skin above may be normal or thickened.

2. Lymphoedema: These are swellings usually affecting the limbs caused by accumulation of fluid due to blockade of lymph flow. This condition progresses from initial fluid accumulation to irreversible swelling called elephantiasis. There are three grades of lymphoedema depending upon the duration of illness, reversibility of swelling and skin changes.

Recent Oedema (Grade I Swelling): Swelling of limbs which appears time to time and the affected part becomes completely normal during intermittent period is termed as acute oedema. The skin above the area is normal. This is curable without any residual swelling.

Persistent Oedema (Grade II Swelling): This follows grade I swelling due to repeated attacks of lymphangitis. Though the swelling waxes and wanes, some swelling always persists. Skin on the swelling is healthy.

Elephantiasis (Grade III Swelling): Years after starting of grade I swelling, skin over it becomes thickened, rough and swelling becomes permanent. Hairs are sparse or absent on skin. This type of skin change with a persistent swelling is characteristic of Elephantiasis.

3. Chyluria: This is a condition where the patient complains of passing milky white urine, caused by admixture of lymph with urine due the rupture of lymphatics into the urinary system.

Entomological survey:

The role of the vector population on the epidemiology of the disease can be studied by monitoring the infected and uninfected mosquito population densities. Adult density can be measured by collecting resting or biting mosquitoes.

a) Resting density

In this method resting mosquitoes are collected by experienced collectors by using torch and aspirators for a specific period of time. This can be calculated separately for indoor and outdoor and can be expressed as number of female mosquitoes per man hour.

b) Man biting density

The number of mosquitoes biting man in an unit time is an useful tool for measuring vector density and this is of great epidemiological importance. Biting density is obtained by collecting mosquitoes biting a man for specified period. Biting collections are usually made during the period of highest activity, which is initially determined after an all night collection (6 p.m. to 6 a.m.). This is expressed as number of females biting per man per night.

All female mosquitoes collected should be dissected for determining age and status of infection.

METHODS FOR CALCULATING FILARIOMETRIC INDICES:

A. PARASITOLOGICAL:

1. $$\text{Mf Rate} = \frac{\text{Number of persons mf positive}}{\text{Total sampled}} \times 100$$

2. Incidence of infection/1000 population/year (in 1-7 year old children). (Kimura, 1985)

$$I = \sum_{i=1}^{7} (1000 \times Pi)/(i \times Ni) \,/7$$

$$= \frac{\left(\frac{1000 \times Pi}{1 \times N1} + \frac{1000 \times P2}{1 \times N2} \ldots\ldots \frac{1000 \times P7}{7 \times N7}\right)}{7}$$

Where I = Annual incidence
Pi = Number positive at 'i'th age sampled
Ni = Number sampled at the 'i'th age

3. $$\text{MFD} - 50 = \text{Antilog} \frac{(5 - a)}{b}$$

a and b are calculated from the probit regression equation

$$Y = a + b \log x$$

Where 'Y' is the probit value of cumulative percentage and 'x' is the mf count, 'a' is the constant and 'b' is the slope of regression

4. $$\text{Mean mf count} = \frac{\text{Sum of mf counts of all positives}}{\text{Number of persons surveyed}}$$

B. CLINICAL:

1. $$\text{Disease Rate} = \frac{\text{Number clinically positive}}{\text{Number surveyed}} \times 100$$

C. ENTOMOLOGICAL

1. Per man hour density ($\frac{OO}{++}$)

$$= \frac{\text{Total number of females collected}}{\text{Number of man hours spent}}$$

2. Parous Rate

$$= \frac{\text{Number of female mosquitoes parous}}{\text{Total number of females dissected}}$$

3. Infection Rate

$$= \frac{\text{Total number of mosquitoes infected}^{*}}{\text{Total number of dissected mosquitoes}}$$

4. Infectivity Rate

$$= \frac{\text{Number of mosquitoes with L3 larvae}}{\text{Total number of mosquitoes dissected}}$$

5. Annual Transmission Index (A T I) = a x b x c
Where

a = Estimated number of mosquitoes biting a man in one year (This is calculated as per man hour biting density x 12 hours x 365 days)

b = Proportion of mosquitoes infective (from biting collections only)

c = Number of infective larvae per infective mosquito

6. Risk of Infection Index (R I I) = a x b x c
Where

a = Average biting density per man hour

b = Proportion of parous mosquitoes

c = Proportion infective to total parous

(*A mosquito is said to be infected if any stage of filarial worm i.e., mf or any of the other larval stages, is found by dissection)

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